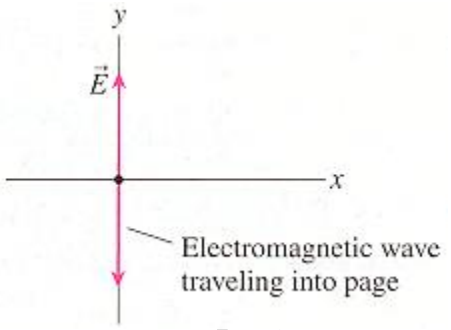
Q- A vertically polarized radio wave of frequency 9.0 ×10^5 Hz traveling into the page. The maximum electric field strength is 1250 V/m.

(a) What is the maximum magnetic field strength?



The relation between electric and magnetic field in an electromagnetic field is given by

$$E = cB$$

Hence $B_{max} = E_{max}/c = 1250/(3*10^8)$

Or $E_{max} = 4.17*10^{-6}$ T

(b) What is the magnetic field strength and direction at a point where $\vec{E}$= (625 V/m, down)?

Again, using the same formula, the magnitude of the magnetic field is given by

$$B = E/c = 625/(3*10^8) = 2.08*10^{-6} \text{ T}$$

As the direction of the energy transport (Poynting vector) is in to the page and is given in terms of cross product of E and B (E×B) according the right-hand rule the magnetic field must be in negative x direction or to the left if E is downwards.

(c) What is the smallest distance between a point on the wave having the magnetic field of part b and a point where the magnetic field is at maximum strength?

If at t=0 and x=0; E is maximum then the equation of the electric field is given by

$$E = E_{max} \cos (kx - \omega t)$$

Hence the distance x of the point where E is 625 V/m at t = 0 from origin (where E is maximum at t = 0 is given by

$$625 = 1250 \cos (kx - \omega 0)$$

Or $\cos kx = ½$

Or $kx = \pi/3$

Now as $k = 2\pi/\lambda$ we get

$$x = \lambda/6 = c/(6n) = 3*10^8/(6*9.0*10^5) = 55.55 \text{ m}$$